WHAT IS CLAIMED IS:

1. A power turbine speed control system for a helicopter comprising:

a) means for generating a power turbine speed signal based upon a demanded rotor speed;

b) means for filtering the power turbine speed signal by effectuating a rapid attenuation of main and tail rotor torsional frequencies in the power turbine speed signal without compromising phase at low frequencies; and

c) a governor for providing isochronous power turbine speed and rotor speed control based upon the filtered power turbine speed signal.

2. A power turbine speed control system as recited in Claim 1, wherein the means for filtering the power turbine speed signal is a high-order filter.

3. A power turbine speed control system as recited in Claim 2, wherein the high-order filter is an eighth order filter.

4. A power turbine speed control system as recited in Claim 2, wherein the high-order filter is configured as three second order filters cascaded in series with two first order filters.

5. A power turbine speed control system as recited in Claim 2, wherein the high-order filter is configured as a sixth order filter in series with a second order filter.

6. A power turbine speed control system as recited in Claim 1, wherein the governor has a sampling time of about ten milliseconds.

7. A power turbine speed control system as recited in Claim 1, further comprising damping means for actively damping main and tail rotor torsional frequencies.

8. A power turbine speed control system as recited in Claim 7, wherein the damping means includes means for estimating a plurality of engine states based upon a single measured engine state.

9. A power turbine speed control system as recited in Claim 8, wherein the single measured engine state is power turbine shaft torque.

10. A power turbine speed control system as recited in Claim 7, wherein the damping means includes a linear quadratic regulator that provides combustive damping.

11. A power turbine speed control system as recited in Claim 7, further comprising means for selectively activating the damping means.

12. A power turbine speed control system as recited in Claim 7, wherein the damping means is tuned to provide attenuation of resonant frequencies so as not to influence low frequency response of the system.

13. A power turbine speed control system as recited in Claim 12, wherein the damping means includes a high pass filter.

14. A power turbine speed control system for a helicopter comprising:

a) means for generating a power turbine speed signal and a power turbine shaft torque signal from a power turbine and rotor drive train;

b) filtering means for filtering the power turbine speed signal by effectuating a rapid attenuation of main and tail rotor torsional frequencies in the power turbine speed signal without compromising phase at low frequencies; and

c) damping means for actively damping main and tail rotor torsional frequencies in the power turbine shaft torque signal.

15. A power turbine speed control system as recited in Claim 14, further comprising means for selectively activating the damping means.

16. A power turbine speed control system as recited in Claim 14, further comprising a governor for providing isochronous power turbine speed and rotor speed control based upon the filtered power turbine speed signal.

17. A power turbine speed control system as recited in Claim 14, wherein the filtering means is a high-order filter.

18. A power turbine speed control system as recited in Claim 14, wherein the damping means includes a Kalman state estimator and a linear quadratic regulator.

19. A power turbine speed control system as recited in Claim 18, wherein the a Kalman state estimator estimates a plurality of engine states using the power turbine shaft torque signal and the linear quadratic regulator uses total energy of the rotor drive train.